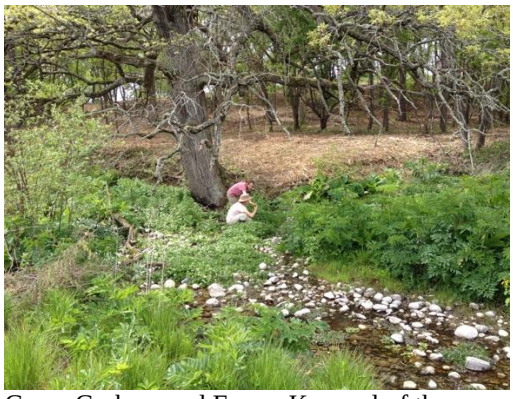
WISCONSIN GEOLOGICAL & NATURAL HISTORY SURVEY



Grace Graham and Emma Koeppel of the WGNHS collecting water quality data from a spring near Lulu Lake, WI. *Photo: David Hart, WGNHS.*

The Wisconsin Geological & Natural History Survey (WGNHS), University of Wisconsin-Extension, performs basic and applied groundwater research and provides technical assistance, maps, and other information and education to aid in the management of Wisconsin's groundwater resources. The WGNHS groundwater program is complemented by the geology and soils programs, which provide maps and research-based information essential to the understanding of groundwater recharge, occurrence, quality, movement, and protection. The Director of the WGNHS is a permanent member of the Wisconsin Groundwater Coordinating Council (GCC) and several WGNHS staff members serve on GCC subcommittees.

FY 2016 Highlights

- Creating an inventory of the springs of Wisconsin
- Studying the potential impacts to groundwater resources from industrial sand mining and irrigated agriculture in Chippewa County
- Developed the Little Plover River groundwater flow model to help people understand the groundwater system and inform management decisions

Details of Ongoing Activities

Groundwater-Level Monitoring Network

Wisconsin's statewide groundwater-level monitoring network has been operated jointly by the WGNHS and the U.S. Geological Survey (USGS) since 1946. As of June of 2016, this network consists of 93 long-term monitoring wells, two spring gaging stations and 57 project-specific, limited-term monitoring wells. The 93 permanent wells and 2 spring gaging stations are located in 45 of Wisconsin's 72 counties. This network provides a consistent, long-term record of fluctuations in water levels in shallow and deep aquifers. In addition, project-specific wells are managed as well as supported with funding from various groundwater studies across the state. While these project-specific wells are only operational over the lifetime of an active groundwater study, they provide substantial cost savings for the network.

Water levels collected from the network help scientists and managers evaluate effects of well pumping, the response of groundwater levels to drought or increased precipitation, and effects of land-use change on groundwater resources. These data are routinely used in the development of regional groundwater flow models. The WGNHS continues to support the evaluation and

maintenance of the monitoring network, aids in data collection, interpretation, and provides information to public and private clients at: *http://wgnhs.uwex.edu/water-environment/groundwater-monitoring-network/*.

The WGNHS, in consultation with DNR and USGS, has recently completed a proposal to add new wells, lake, and stream gages to the monitoring network in four areas where high capacity well applications are prevalent and water level data is sparse. These areas include: the Antigo Flats in Langlade Co.; several sites near the groundwater divide on the eastern edge of the Central Sands (Adams, Marquette, Portage and Waushara, Cos.); and in the Southern Rock River Valley in Rock Co. And lastly, in an area in West Central Wisconsin (Dunn and St. Croix Cos.) where we hope to partner with the US Fish and Wildlife Service and potentially use existing wells present on federal or state lands when those properties were acquired.

County Groundwater Studies

Geologic and groundwater studies at the county scale continue to be an important part of WGNHS programs. With funding from the federal STATEMAP program or local sources, WGNHS scientists initiated or carried out geologic and/or groundwater studies during FY 2016 in twelve different counties. Many of these studies will generate or have generated *water-table maps*. Lists of current projects are maintained at: *http://wgnhs.uwex.edu/research/water-resources/*.

Regional Groundwater Studies

Regional groundwater studies usually span multiple counties. During FY 2016 the WGNHS was involved in several regional projects, including the following:

a. *Hydrogeology of the Chequamegon-Nicolet National Forest*. In cooperation with the USGS, and with funding from the US Forest Service, the WGNHS is nearing completion of a multi-year study of the hydrogeology of Wisconsin's National Forests. This effort consists of characterization of the groundwater system and development of groundwater flow models to improve management of forest resources. The project covers four forest units across eight counties in northern Wisconsin. A comprehensive technical report for each forest unit is scheduled for publication in FY17

b. *Hydrogeology of the Agricultural regions in Bayfield County*. In FY 2016, the Large-Scale Livestock Study Committee of the Bayfield County Board requested WGNHS assistance to assess groundwater contamination potential in agricultural areas within the county. Staff compiled and analyzed available geologic and hydrogeologic information and completed a report: *http://wgnhs.uwex.edu/pubs/000934/*


View from a frac sand mine in Chippewa County. *Photo: Madeline Gotkowitz, WGNHS.*

c. *Hydrogeology of the frac-sand mining district in western Chippewa County*. This five-year *study*, commissioned by the

Chippewa County Department of Land Conservation and Forest Management in 2012, is a cooperative effort between the USGS and WGNHS. The project evaluates potential impacts to groundwater resources from industrial sand mining and irrigated agriculture. This effort includes development of a groundwater flow model and a series of annual informational meetings to update the public about study results and water resources in this region of Wisconsin.

d. *Groundwater flow in the Mukwonago Basin*. In cooperation with the USGS, and with funding from The Nature Conservancy, the WGNHS is building a groundwater flow model. This model will be used to understand the impacts of possible land use changes and groundwater pumping to the wetlands of the Mukwonago Basin.

Groundwater Research Activities

The WGNHS carries out specific groundwater research projects focused on understanding topics important to groundwater use and management in Wisconsin and elsewhere. Active research areas during FY 2016 included the following:

a. *A new model of the Little Plover River basin and surrounding areas, Portage County*. This *project* addresses continuing concerns over the potential effects of irrigation on groundwater levels in Wisconsin's Central Sands region. A new computerized groundwater flow and optimization model for the region was developed that can help people understand the groundwater system and inform management decisions.

Drainage in the Little Plover Basin. *Photo: Ken Bradbury, WGNHS.*

b. *Viruses in groundwater*. WGNHS scientists completed a two-year *study* funded by the US EPA that addressed impacts to groundwater quality from leaky sewers. The study found that a combination of factors, including the age of sanitary sewer infrastructure and local climatic conditions, affect the transport of pathogens from sanitary sewers to water supply wells. WGNHS staff continue investigations at the sites used for this study to evaluate use of novel wastewater tracers, such as pharmaceutical compounds, to assess the quality of urban groundwater. A *fact sheet* related to this project describes important implications for Wisconsin's groundwater quality and municipal drinking water supplies.

c. *Radium studies.* In FY 2016, WGNHS scientists received funding to investigate the geologic sources of radium to groundwater in Wisconsin's sandstone aquifer. This two-year study addresses a significant problem for many municipal water supply systems, such as the City of Waukesha, where deep wells produce water with elevated radium.

d. *Nitrate study*. In FY 2016, WGNHS assisted the DNR with source water protection at public supply wells impacted by elevated nitrate. The WGNHS designed, installed and operated monitoring systems at two sites. At one locations, the WGNHS is working with

cooperating land managers to quantify nitrate loading to the underlying aquifer under an irrigated corn crop.

Groundwater Data Management and Support

In FY 2016 the WGNHS continued to collect geologic and groundwater data and provide this data to a variety of users. Significant databases and data efforts include the following:

a. *An updated springs inventory for the State of Wisconsin.* The WGNHS is in year-2 of a 3-year effort to inventory the springs of Wisconsin. This inventory serves as both as database of flow springs greater than 0.25 cfs for use by the WDNR for their high capacity well approvals. It also provides for study of reference springs. These springs are selected in representative hydrogeological and ecological settings for long term monitoring to provide better understanding of springs and potential impacts from land use and groundwater withdrawals.

b. *Properties of Wisconsin aquifers.* The DNR funded a project to compile readily-available storage information and other hydraulic properties for Wisconsin aquifers, particularly in areas where high-capacity well applications are most common. Previous compilations of the storage properties of Wisconsin aquifers have been made, however, these datasets were relatively sparse and lacked of citations for aquifers in many parts of the state. Over 800 records were compiled in database and then made available to the DNR as a spreadsheet, as GIS layers, and through the Hydro Data Viewer application.

c. *Data viewer maintenance.* The WGNHS continues to develop and support the Hydrogeologic Data Viewer, a map-based application to access a statewide catalog of hydrogeologic data. The application provides DNR staff with efficient and timely access to statewide hydrogeologic data, and includes several methods to search by area for data of interest, such as geologic and geophysical logs or well construction reports. DNR and WGNHS are in discussions related to public accessibility for this application. Many of the geophysical logs are collected for the WDNR in wells where water quality or lack of data is an issue.

d. *wiscLITH database*. The Survey provides annual updates of the digital database, *wiscLITH*, which contains lithologic and stratigraphic descriptions of geologic samples collected in Wisconsin. This is a publicly available database, and current work efforts focus on including more data for areas of the state with active geologic and hydrogeologic projects.

e. *Well construction reports.* The WGNHS serves as the repository for well constructor's reports (WCRs) from wells installed between 1936 and 1995. These reports were usually submitted to the DNR by a well driller within a few months of a well's completion. The *database* and scanned images are now available to state agencies, consulting firms, and private well owners on CD-ROM and paper copies. In FY 2016 WGNHS provided an updated set of these records to DNR for internal use. This update includes corrections to the records made by WGNHS over the past several years.

f. *High-capacity well approval tracking.* In collaboration with the DNR, WGNHS is now tracking high-capacity well approvals in an internal database. This enables a more

proactive approach for WGNHS researchers to work with well drillers, pump installers, and consultants to collect samples and borehole geophysical logs from priority areas of the state.

g. *Tillpro Database*. TILLPRO is primarily a *database* of grain-size analyses performed on unlithified sediment samples collected from Wisconsin and analyzed in the Quaternary Laboratory at the Department of Geoscience, University of Wisconsin-Madison. The data are available for public distribution on CD-ROM.

h. *WGNHS Research Collections and Education Center (RCEC).* The WGNHS archives geologic records, rock samples, core samples, and other materials in Mount Horeb, Wisconsin. Currently the *RCEC* contains over 2.5 million feet worth of drillhole cuttings, more than 600,000 feet of drill core, and more than 51,000 individual hand samples of rock from across the State. Examination tables and basic laboratory facilities at the RCEC allow convenient analysis and study of these materials by qualified individuals.

i. *Physical properties of Wisconsin's bedrock aquifers and aquitards.* This *database* contains porosity, density, thermal conductivity and specific heat of core samples collected from across the state. Data include high-resolution images of core taken from various depths along with a summary table.

Groundwater Education

WGNHS groundwater education programs for the general public are usually coordinated with the DNR or the Central Wisconsin Groundwater Center at UW-Stevens Point. The WGNHS also produces and serves as a distributor of many groundwater educational publications. More recently, we have expanded our outreach efforts to reach different audiences through a variety of social media tools, including:

- *Facebook* - *https://www.facebook.com/WGNHS*
- *Twitter* - *https://twitter.com/wgnhs*
- *Pinterest* – *http://www.pinterest.com/WGNHS/*
- *YouTube* –*https://www.youtube.com/channel/UCwwucf9-W1qocovGx-uzs7w*

WGNHS presents groundwater educational activities at Farm Technology Days, at the Wisconsin State Fair, at various children's museums and schools, and at UW-Madison events (such as at Science Expeditions and at the Science Festival).

In FY 2016, WGNHS staff members participated in groundwater educational meetings in counties where mapping and/or hydrogeologic studies are in progress, particularly in Bayfield, Chippewa and Columbia Counties. Staff provided groundwater education at several public meetings in Green County in FY 2016. Staff members will continue to work with the DNR and the Central Wisconsin Groundwater Center on teacher-education programs connected to the distribution of groundwater sand tank models.

The WGNHS maintains a long commitment to the continuing education of water well drillers, pump installers, and plumbing contractors through participation in the programs of the DNR and the Wisconsin Water Well Association. Geologic and hydrogeologic field trips and presentations

for DNR water staff and new DNR employees have been held in the past and will continue as requested. WGNHS geologists and hydrogeologists presented a seminar on trace metals in groundwater during a meeting of the DNR's Advisory Council on Well Drilling, Heat Exchange Drilling & Pump Installing.

Multiple WGNHS staff members gave presentations at the Wisconsin Society of Science Teachers conference helping to increase our efforts to reach teachers in FY 2016. Additionally, our Research Collections and Education Center is providing a locale for various groups, such as the Wisconsin Rural Water Association, to conduct related educational programs. Researchers and consultants also use our core holdings in that collection to better understand the subsurface and its aquifers.

For more information

Visit http://wgnhs.uwex.edu/

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